Hantavirus Risk Assessment Form

The purpose of this document is to provide guidance in evaluating a residential, business, or recreational structure and the risk of hantavirus transmission to the occupants. Transmission of hantavirus that results in human infection and disease likely depends on many factors, not all of which are thoroughly understood. Host susceptibility, virus strain variations, and other unknown or unmeasurable components may play a role in the epidemiology of hantavirus cardiopulmonary syndrome. This document focuses on those known risk factors that can be directly observed and evaluated.

The assessment conducted via this form provides an indication of the general risk of hantavirus transmission. However, through awareness, modifications, and practice of personal protective measures an individual can significantly reduce his/her likelihood of disease even in areas of high background risk. The observations and conclusions regarding hantavirus risk, as assessed by this document, should be provided to the resident, property owner, and/or property manager as an education tool to motivate them to take appropriate measures to prevent or eliminate rodent infestations.

1. Evidence of interior rodent infestation.
Indirect evidence of rodent activity inside buildings includes: feces, nests, gnaw marks, gnaw holes, consumed food, urine odor, scurrying or gnawing sounds. A semi-quantitative assessment of the severity of infestation may be made from the density and prevalence of these indirect signs—for example, a few droppings in one room versus large numbers of droppings in several rooms. The duration and current level of infestation can be estimated through the character of evidence. Large accumulations of dried droppings may indicate a past infestation, compared to small numbers of fresh droppings which may suggest an active or incipient rodent problem. In addition to directly observable evidence, reports by building occupants of damage, fecal contamination, nests, and noise (e.g., gnawing) caused by rodents can provide supplementary information on the extent and duration of the infestation.

2. Rodent species.
While any rodent infestation in a human dwelling is a potential public health concern, determining the species of rodent infesting a building is critical to evaluating the risk of hantavirus exposure. Current evidence indicates that only deer mice (*Peromyscus maniculatus*) are viable reservoirs of Sin Nombre virus and can serve as a source of infection. Documenting whether, and how many, deer mice are active inside the building is necessary to assess hantavirus risk. Large numbers of other rodent species (e.g., *Mus, Rattus*) may actually decrease risk by providing competitive inhibition for invasive deer mice.

3. Incentives and access for rodent infestation.
As deer mice enter buildings from the outside environment principally for shelter and food, the building should be evaluated to identify incentives for deer mouse infestation. Open food containers, accumulated food waste, spilled food can attract rodents. The building exterior should be examined thoroughly to identify structural defects that could serve as points of ingress for wild rodents. Dense shrubs, woodpiles, and other junk which accumulates around the
building can provide peridomestic shelter for wild rodents.

4. Interior environment conducive to virus transmission
Many factors are necessary to effect transmission from rodents to humans. Virus must be present in sufficient quantities and, once shed, transported within a fairly narrow window of time to a susceptible human. Most transmission of SNV is believed to be through aerosolization of infectious excreta. The density of aerosolized virus is enhanced in confined, poorly ventilated enclosures. The locations of rodent infestation should be evaluated relative to the frequency and nature of human activity in those same areas. A few rodents in a small, windowless utility/laundry room may present a greater risk of hantavirus transmission than many rodents in an infrequently used storage cupboard in a well-ventilated area.

5. Virus activity
SNV has been detected in numerous deer mouse populations in nearly all ecologic habitats throughout California. Collecting and serologically testing deer mice is the method by which SNV is most commonly detected in rodent populations. Documenting evidence of SNV activity in the infesting rodents can provide additional insight into the risk of HPS. However, as serology provides only an indication of exposure to the virus, and not necessarily active shedding, the estimated seroprevalence alone is not a sufficient determinant of risk. Seropositive rodents may not be currently infected/shedding and conversely actively infected rodents may not have seroconverted at the time of testing. Nevertheless, in the absence of any previous data on hantavirus seroprevalence in the area under evaluation, if time and resources permit, serologic testing of deer mice, both within and outside the building, can provide valuable information. Epidemiologic association of a given building with a confirmed HPS case would also be strong evidence for virus activity.

6. Surrounding environment
In addition to the level of interior infestation present at the time of the risk assessment, the potential for migration of deer mice from the surrounding environment should be considered. Is the building located in an environment that provides suitable habitat to support deer mouse populations? Deer mice can be found in undeveloped areas throughout California. Urban, metropolitan areas are less conducive to support deer mice. The general ecologic environment, including type and density of vegetation, rocks, and other ground cover should be noted. Elevation, climate, and degree of development should also be considered.
California Department of Public Health  
Vector-Borne Disease Section  
**Hantavirus Risk Assessment Form**

Site name **Tuolumne Meadows Lodge**

Site address **Tuolumne Meadows, Yosemite National Park**

Resident/Property owner/manager **Syd French**

Name Telephone No.

Property use: Residence Business Recreation Other ______________________

Reason for assessment **Recent human HCPS case**

Date 9-15-2010 Time 1300 Weather Clear, sunny

**Risk assessment factors** Describe findings and assign score of 0-5 points each  
(0=not present or no risk, 1-2=low risk, 3-4=moderate risk, 5=high risk)

1. **Evidence of interior rodent infestation:** Mouse feces in sink of linen storage building. Cabin #56 is suspected site of exposure, but was occupied and unavailable for inspection. A nearby similar canvas-sided cabin that was available for inspection was free of rodent sign. {4}

2. **Rodent species:** *Peromyscus maniculatus*, based on feces appearance and previous VBDS surveillance at Tuolumne Meadows. {4}

3. **Access and incentives for rodents:** Gaps in base of tent cabin canvas walls (2-3 inches). Gap in canvas around chimney exit hole (.25 inch). Door not tight fitting, gap at threshold (.25 inch). Open containers of water could be an attractant. {4}

4. **Interior environment:** Blankets touching floor, bed touching wall giving access to rodents. Debris and dust in pocket formed at base of canvas will aerosolize when wind blows. {3}

5. **Hantavirus activity:** Recent human case, #56 in California since 1980. Incubation period and activity of case patient was consistent with exposure to hantavirus cardio-pulmonary syndrome (HCPS) at this location. Past VBDS surveillance events documented the presence of Sin Nombre virus (causative agent of HCPS) in Tuolumne Meadows. In 2007 and 2008, 16.7% and 24%, respectively, of captured mice tested positive for exposure to Sin Nombre virus. {5}

6. **Exterior environment:** Cracks and crevices of foundation rock facings provide rodent harborage. Harborage outside linen storage building consisting of crumpled rugs and miscellaneous debris. Wood piles possible attractants/harborage. Tree limbs touching cabin roofs can provide additional access points. {4}
**Additional observations & notes:** No written protocol for making bleach solution to sanitize tents and maintain an effective concentration of active ingredient. Small, handheld spray bottles are inadequate to sterilize tent cabins. Brooms have been removed from cabins but are stacked outside linen building. In linen building, linen was piled in bundles on shelf and accessible to mice. Semi trailer full of wood is another possible enclosed space that could be infested by mice and be a source of HCPS exposure for workers who enter and move wood. Mice can’t be excluded from tent cabins and interactions with humans can only be minimized.

Risk Assessment Total Score: 4.0

**Recommendations:** Establish a written protocol on making bleach/Lysol solutions so all employees understand procedures and ensure product efficacy. Replace hand operated spray bottles with pressurized sprayers. Conduct mandatory employee training for adherence to protocol and use of pressurized sprayers. Investigate advantages of using commercial disinfectants (e.g., Lysol) vs. bleach.

Inside tents, open pitchers of water should be replaced with sealed receptacles. In linen building, store linen in bins to limit mouse access and harborage.

Firewood intended for use in cabins should be removed from the trailer forty-eight hours prior to use and be placed in a well ventilated, sunny area. Wood should be retrieved from the trailer with minimal disturbance (to minimize aerosolization of dust). Gloves that can be disposed or easily disinfected should be worn while working with the wood. The trailer door should be shut when not in use. The firewood supply should be regularly rotated to not create permanent rodent harborage. If rodent infestation is noted in the trailer, access should be limited and respiratory protection should be considered when working in this enclosed space, until the infestation is eliminated.

Examine facility grounds to eliminate any excess materials or debris that could serve as a rodent attractant or harborage.

Eliminate brooms and dustbins that are currently stacked outside linen building. Replace cloth rugs outside cabins with plastic or rubber mats that can be easily disinfected.

Provide each cabin with information on HCPS. Together with the bear safety guidance, guests should be advised to minimize contact with rodents and to report signs of rodent intrusion (e.g., droppings, chewed items) to Tuolumne Meadows Lodge management.

Evaluator: Michael Niemela 9-15-2010